THE GERM OF THE SOUTHERN CATTLE PLAGUE.

BY FRANK P. BILLINGS.[1]

IN order to prove that it is the manure of infected cattle which lodges the germs of Southern Cattle Plague, we must first find the germs.

Has anybody found them? To which I answer that there has, and that the honor belongs entirely to Nebraska, as well as does that of completely connecting the germ of swine plague with that disease, and discovering the true nature of that pest. Detmers saw the germ of swine plague first, but it was left to us to prove its unquestioned connection with that disease. Our discovery of the germ was as original as if it had never been discovered, but in no way detracts from Dr. Detmers' credit as the first discoverer.

Detmers found a germ in the Southern Cattle Plague, but it was a large baccillus, and had no direct connection with the disease. Salmon found another coccus in this disease, also, but it was a double coccus, and had no relation to it. These observations will be considered in detail in our full report. How may we know that we have discovered the germ in any specific disease? In order to make such an assertion the following conditions must be fulfilled in every detail:—

First.—In the tissues of animals ill with a specific disease must, in each case examined, be found the same germ.

Second.—This germ must be cultivated, free from every other germ, in some of the artificial media.

Third.—It must be shown that the germ in question has pathogenetic (disease-producing) qualities, by inoculating animals and killing them thereby.

These three conditions have been fulfilled. The germ of Southern Cattle Plague has been found in the blood, the gall, the urine, the liver, spleen and kidneys of every diseased animal on which we have made an autopsy. These germs have been also cul-

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tivated in an absolutely pure form upon and in artificial media. Gophers, or ground squirrels, have been inoculated with such cultivations and died from the effects, and the same germ found in their blood and tissues, and in sections made from their organs. Cultivations from the same have been also made, invariably showing the same germ as that got from the cattle.

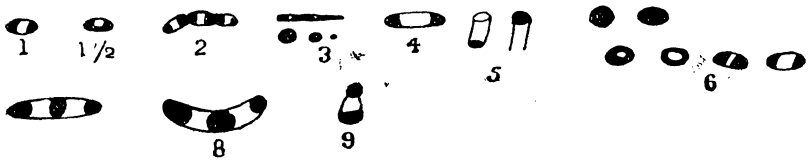
These results, however, do not show that this was the germ of Southern Cattle Plague. They only show that a germ was found in the tissues of Texas fever diseased animals that had fatal disease-producing properties.

How, then, can we tell that it is the specific germ of the Southern Cattle Plague?

To be able to affirm this fact positively cattle must be inoculated, as the ground squirrels were, with unquestionably pure cultivations, and the Southern Cattle Plague produced in those cattle, and the same germ found in their tissues and cultivated from them. We have done this, and can demonstrate the entire series of facts by cultures and microscopic specimens of the tissues.[1]

[1] Above I have stated the conditions which must be fulfilled in order to completely substantiate the discovery of a specific germ. I wish, however, to call attention to the discovery of another pathogenetic organism in which these conditions cannot at present be fulfilled and may never be so conclusively as we are enabled to do with germs of animal diseases. I allude to the germ of Yellow Fever, for which I claim not only the first discovery by an American, but for the only exact description of it. Babes saw it and partially described it, "Les Bacteries-Babes-Cornil," 1885, as follows:—

'The capillaries of the liver and kidneys contain great numbers of jointed filaments. With a Zeiss $\frac{1}{18}$ H. I., one sees these filaments to be made up of elliptoid-cylindrical granule united in pairs, or forming small clusters, in which *they are united by a pale intermediate substance.* The filaments are thus made up of diplococci or of very short segments," p. 448. In the "Comptes Rendus," Aug. 1887, p. 289, Lacerda attempts to describe an organism which he says is the same as that described by Babes, but his description is such a lamentable failure that no one would recognize the germ from it. In pieces of liver and kidneys from a case of "Undoubted Yellow Fever," sent me by Dr. Geo. M. Sternberg, I discovered the same organism described by Babes, and, no other being present, and the yellow fever a specific septicæmia, and this organism belonging to the same group, I make no hesitancy in affirming that it is the germ of the yellow fever, even though unable to fulfill all the necessary postulates of exact experimentation. On the other hand, the description of the germs of the Southern Cattle Plague and Swine Plague belonging to the same group, and an accurate knowledge of several others belonging to this species, warrants the assertion that this



MORPHO-BIOLOGICAL CHARACTERISTICS OF THE GERMS OF THE SOUTHERN CATTLE PLAGUE AND THE AMERICAN SWINE PLAGUE AND THEIR POINTS OF DIFFERENTIATION.[1]

These two micro-organisms are neither to be classed with Micrococci or Bacilli. They are not round objects like the former or rods like the latter. They belong to the intermediate group, to which the name "bacteria" has been given. Their longitudinal dimensions are about twice that of their transverse. They are ovoid. Their ends are rounded. If an endeavor be made to differentiate these germs from one another by a microscopic examination we shall find it impossible. They are approximately of the same size and shape. Fresh specimens of them both will not differ so much in dimensions as old cultures of either will from fresh ones, or different individuals in the same old cultures. They are description will answer in nearly every particular and every chief essential. The only points where a difference may be found will be these:—

1. The yellow-fever germ may cause gelatine to become fluid but probably not as no other of these germs does.

2. It may grow differently on potatoes and egg albumen.

In this regard attention will be called to the difference between the germs of the Southern Cattle Plague and Swine Plague when developed on potatoes. Now I have still another and hitherto unknown germ of this same group of which more will be heard later on.

On potatoes, the Swine-Plague germ grows a light gray-brown, coffee-colored; the Cattle-Plague germ in yellow colonies becoming reddish, this new germ pure white.

On whites of eggs, the Swine-Plague germ grows in a semi-fluid almost pure white colony, difficult to see.

The Cattle-Plague germ develops in a delicate buff color with sharply circumscribed walls, while the new organism grows in deep yellow colonies with diffuse edges. However, I feel that aside from these points, the description herein given will answer completely for the germ of the yellow fever. Morphologically it cannot be distinguished surely from either of them.

[1] With the exception of the points to which attention has been called as to the germ of Yellow Fever.

about $\frac{1}{6}$ the transverse diameter of a red-blood cell, in length. In one way, however, they can be easily differentiated even by microscopic examination. *The swine-plague germ has a far sharper affinity (its poles) for the blue and violet tinctions than that of the Southern Cattle Plague, while the latter possesses a special affinity for Fuchsin, which the former does not.* Whatever the tinction used, if applied *lege artis*, the ends, poles, of these micro-organisms show a great specific affinity for the coloring material, *while the middle portion of their bodies has far less*, unless the exposure is pushed to a longer period, when this portion of the body will eventually color. The capsule of these germs seems to be composed of the same material as the ends, as it also colors in the same manner, thus presenting a delicate line of colored material, connecting the two colored, coccoid ends, or poles.

The most practical illustration which can be given of the microscopic appearance of these organisms, is to take a small white bean and paint both of its ends and two of its sides blue or red, leaving the middle portion unpainted. Looking down upon such a bean would give almost an exact picture of these germs.

Like the genuine and only germ of the American Swine Plague the micro-organism of the Southern Cattle Plague *is motile in fluid cultivating media when studied microscopically, as well as in the serum from the blood of diseased animals.*[1] The movements of the latter are, however, *less rapid or active* than those of the former organism.

In my earlier description of the micro-organism of the American Swine Plague, I called attention to the great morphological variations which it undergoes in its full cycle of development. These are its morpho-vegetative phenomena.

To one entirely unaccustomed to observing them, the first appearance of a cultivation of these germs—more especially an old one—would prove very puzzling. In fact, the novice would very often conclude that his cultures had become polluted by micrococci, so plentifully are these objects, apparently, represented. They simply represent a vegetative, embryonic, period in the development of this class of micro-organisms.

[1] For some, to me, unaccountable reason the German observers say the germ of the German Swine-Plague is not motile and Cornil says the same thing. *Now I positively assert the micro-organism of these two American diseases to be motile as well as a third one which I am not yet ready to describe.*

Hueppe has fallen into the serious error of endeavoring to classify these organisms by this vegetative morpho-condition. He calls them "Micrococci." To my mind it would be equally sensible and logical to call an ovum a man, or an apple seed an apple tree. It is far more practical for patho-biologists to stick to the name cocci for all round objects (not spores) which have equal diameters in their mature form and which color diffusely, and to call these ovoid organisms bacteria, where the longitudinal diameter does not more than over again exceed the transverse. As to bacilli, spirilli, etc., there need be no dispute, so plain are their morpho-characteristics.

The mature micro-organisms of the American Swine Plague and Southern Cattle Plague has been described above (Fig. 1) as resembling a white bean with the ends painted as well as its sides, leaving the middle portion of its body unpainted, as we look down upon it. Now that is the picture which the eye generally receives, but a more exact inspection of a stained covering glass specimen will show that the above is not always the appearance presented to the eye, even by the mature germ.

The above description depends upon the germ presenting itself to the eye in an exact horizontal position, that is, lying straight on its horizontal axis. If, however, it be turned a little one way or the other on its horizontal axis, numerous specimens will be seen where the white belt does not extend entirely across the object, as above described, but seems to be limited, more or less, to one side, and more of the colored substance will be seen on the opposite side than under general circumstances, or, perhaps better, in exact inspection (Fig. $1\frac{1}{2}$). At first I mistook the appearance for the accumulation of the uncolored substance in this way during the process of its secretion from the colored ends, which I take to be the method by which this non-coloring material is produced. More mature reflection has shown me that the above explanation is partially or wholly incorrect. It has been mentioned that that portion of the capsule of these micro-organisms must have the same chemical composition as the pole ends, because it also colors somewhat under the same application of the tinction. Now why does it not show the same intensity of coloring? The only answer is: *that this capsule, being very thin, cannot take up as much color as the more dense pole ends; and being so thin, by the same amount of exposure, does not show any color when the middle of the object is looked directly*

down upon, but when the eye strikes the sides of the object, then we look through more material and, hence, see more color, just as when we look at a piece of window glass or a good glass slide. If we look directly through it, it is colorless, but if we turn it on edge and look at it, it has a more or less green shade, according to the quality of the glass. So according to the amount of exposure to the tinction, when not carried so far as to color the whole body of the germ, we have more or less visible coloring of the capsule, which can only be seen when we look through a considerable extent of substance, that is, on the sides of the object. Again, we may see two or three objects united together, all presenting the normal characteristics of full maturity. I have never yet seen more than three of these germs connected together (Fig. 2). In general they either appear singly or in pairs. In very old cultures these micro-organisms become thinner, more rod-like, and color more diffusely with the same degree of exposure to the tinction, and the white substance is either not visible at all or very faint (Fig. 3). Again, such old cultures are very replete in apparent micrococci, of various dimensions, which might lead one into the error of thinking that his cultures had become polluted. I call this last condition *that of coccoid degeneration* (Fig. 3). Or, we may see unusually long objects, the longitudinal diameter being twice or three times that of the mature organism, and the white, or uncolored, substance occupying a corresponding extensive amount of space, while the dark, or colored, ends may be somewhat larger or of the same size as those of the mature object. *This condition represents the first step in the development of these organisms, that is, they become longer, and more of this white substance appears* (Fig. 4).

The next step in the process of vegetative development is the separation of one of the pole or coccoid ends, which then becomes free, and for a moment is exactly round like a coccus, and, as in a hanging drop culture (to which I always add a very small amount of an aqueous coloring solution), one will naturally see a very large number of these coccoid objects on account of the fact that each individual present is continually going through the same process of multiplication. Here, again, one may see a condition or phenomenon that might be misleading.

One of the coccoid ends having been separated, the other may still remain connected with the white material, and as evidence that the colored ends have a greater degree of specific gravity, as well

as chemical composition, you will see, in the continual tumbling about, and turning over and over of their objects, *a white, round or nearly so, colorless object directly under the eye, or numbers of these objects.* When the germs in such a hanging drop culture have died from want of a sufficiency of nutrient material, you may see a large number of these objects, *which could be easily mistaken for spores:* but if we inoculate a new hanging drop culture from the same material used to prepare the former, it will be found impossible to fall into any such serious error, for it will be easily seen that these non-colored refracting points keep continually going out of sight, their place being taken by the coccoid non-refracting point still attached to the other end of the white substance, and by watching one and the same organism in its continual turning over, first one appearance and then the other will be presented to the eye until the second coccoid end has become detached (Fig. 5).[1]

What becomes of the uncolored transparent middle piece?

I do not know!

It appears, however, as if it underwent an almost immediate process of dissolution the moment it has become free from both of its polar attachments. That this substance does not represent a spore condition, or have any relation to spores, is to my mind entirely beyond all question, as I have searched most diligently for spores in old and fresh cultures, and others made at all kinds of temperatures, within the biological limits of these organisms.

In my first-published description of the micro-organism of the swine plague I gave an erroneous description of the manner in which the coccoid ends became freed from the white or connective substance. *This white, non-refracting, uncolorable material does not become extended to nothing, and then break in two, leaving the coccoid ends with a delicate, colorless flagellum, or spermatozoid tail, temporarily attached to one side,* as I then said, and as Detmers described it in 1880; *but the separation of these ends is direct, and by sharp segmentation. Were it otherwise we could not see the sporoid colorless ends of so many of these germs when freed from their appropriate pole ends.*

There are days when one cannot study them continuously at all. The best way to study hanging drop cultures, when one desires to spend several hours over them, is to first make some cover-glass

[1] Coloring such a specimen will at once show that no spores are present.

specimens of the same material, or take any other slides of an object of the same size and form, and observe such for about half an hour, thus preparing the eye to see what you want to see in the living developing organism. Unless this is done, some very essential points will be surely missed, and some preventable error fallen into. With anything less than a power of 800 diameters no one should attempt to study these organisms, and then only when aided by the best of Abbe condensers and oil immersion lenses.

We left our studies with the mature object proliferated into its first distinct stage of vegetative di erentiation. We had two coccoid objects before us, that is, two round objects, their diameters being the same in any direction. If colored, they color throughout, that is, diffusely.

Were these objects to remain in this condition, they would be, indeed, *Micrococci.* They do not, however. They almost immediately begin to increase in a longitudinal direction, but in this condition they still stain diffusely.

In my first description of the swine-plague germ, I said *that the next biological phenomenon was the appearance of a delicate white line, separating this ovoid object into two halves.* The above, while not exactly an erroneous description, is certainly anticipated by another phenomenon in the evolutional development of this coccoid, diffusely coloring object, into the mature form of any of this class of germs. *That this white non-coloring substance is a secretion of the two poles, or coccoid ends, of these "belted" germs, as well as that it has a different chemical composition, is beyond all question.*

The phenomenon above spoken of, as anticipating the formation of the segmenting white line which separates the two darker portions of these organisms is: *that this white substance first appears in the centre of the body of the dense, dark ovoid object as the minutest of white specks, which gradually increases in size and quantity, and extends across the entire object;* the white line, *being at first broader in the middle, but gradually widening until it completely and clearly separates the two pole (coccoid) ends, and the mature object is again presented to our view* (Fig. 6).

We have thus described the normal, or general, cycle of development of the micro-etiological organism of the *American, English and German Swine Plagues, the American Southern Cattle Plague, Hen Cholera, the German "Wild-Seuche"* (of deer, swine and cattle) and *Rabbit Septicæmia,* all of which diseases are caused by a

member of this class of "belted" germs, and should be classed as extra-organismal, local or land septicæmiæ. It seems to me that the germ of Yellow Fever, as well as the disease itself, should also come into this group.[1] I am sorry to say that, notwithstanding the results claimed by Freire, I am unable to find a single exact and detailed description of the germ with which he works, and which should therefore be the etiological moment in the Yellow Fever, if there is any trustworthiness in Friere's statements.

Morpho-biological Resemblances not sufficient to Pronounce Pathogenetic Germs or Diseases caused by them Identical.

This part of my work would be left incomplete did not I allude to an endeavor of Hueppe's to show that the diseases named above, aside from the Swine and Southern Cattle Plague of this country, are *identical*, that is, the German, Schweine-Seuche, Hühne-Cholera, Kaninchen Septikamie und Wild Seuchë must all be one and the same disease; *because their germs have each and all the same form, the same size, the same "belted" appearance, and because they all grow alike in bouillon, on agar agar and in gelatine.*

The Germans do not say anything as to how these germs deport themselves on potatoes. *The Schütz-Loeffle germ does grow on potatoes*, as Professor Kitt, of Munich, assures me.[2]

No greater or more misleading statement could be made, or perhaps it would be better to say principle or theory enunciated.

The most complete morphological resemblances and exact morpho-biological relationship in or on artificial media are not sufficient grounds for any such attempt at generalization as Hueppe's in the case of these diseases.

To all beginners in this work, and all older hands as well, I most emphatically assert that there is but one factor in the biology or morphology of etiological micro-organism which can decide whether two germs apparently alike are one and the same object, when derived from two distinct diseases of animal life.

That factor is a physio-chemico-biological one. Both germs must produce the same disease in both species of animals: the same chemical and pathological phenomena which occur in the same diseases and

[1] Confirmed as herein stated by researches subsequent to the preparation of this paper.

[2] Colin says the same.

in the same species of animals under natural conditions, when healthy animals of the given species are inoculated with artificial cultivations of the germs in question. Our experiences here completely upset Hueppe's hypothesis.

The American Swine and Southern Cattle Plague should, accord ing to Hueppe, be identical diseases with those mentioned as considered so by him in Germany, because, according to his condition, *the germs are identical.* Hueppe's entire argument is completely nullified by the following facts:—

First.—*There is no Southern Cattle Plague known in Europe.*

Second.—*Cattle and Swine run together in this country, and one or the other may have respectively Swine or Cattle Plague, and yet the other species will never become ill, even from the closest contact with members of the other species sick with its peculiar plague.* Hens can feed on hogs dead from the swine plague, from the ground polluted with their discharges, even picking out grain from the same, and still remain well; and the same is true of the hogs with regard to Hen Cholera and the Southern Cattle Plague.

Hence, no matter how these germs may resemble each other, when artificially examined, they fail in the one great factor necessary to make the diseases produced by them identical; they do not have the same physiological chemical attribute with regard to a given something produced, which invariably decides the pathogenetic results produced by a given germ. Notwithstanding the latter fact, these diseases all have a very close relation to one another. *They are all extra organismal, local land septicæmiæ.* Each one, however, has something peculiar about them that prevents them from being identical diseases, aside from any action of the germ.

Each species of animal in which they occur has some unknown constitutional idiosyncrasy which renders its members susceptible to the action of a given germ, and each of these germs has some peculiar unknown biological idiosyncrasy by which alone it infects, naturally, but a given species of animal life.

These two factors, together, can alone decide the identical question. What we can do artificially, by the inoculation of those animals that the disease does not occur in naturally, has no necessary relation to the question whatever.

There are, however, other phases in the development of these germs of a bio-morphological character. For instance, as already said, we may see two or three individuals of the mature type united

together (Fig. 2), or we may find two apparently mature organisms enclosed in a common capsule, the two medial dark points or poles being in such close apposition that no line of demarcation or indentation of the capsule can be seen at this point, the whole outer surface being smooth (Fig. 7). On the other hand, the two lateral ends, or free poles, are separated by the normal quantity of white, non-colorable substance.

Again, these diplo-bacteria may assume a curved or sausage shape, which we may sometimes see intimated in the single organism, mature (Fig. 8). At other times, though not very frequently, the germ may appear in nearly its normal form, but one pole (coccoid) end will be semisegmented from its appositional end of the white substance by a constriction of the same at its line of attachment with the pole end (Fig. 9). This end will then be smaller than the opposite pole, thus giving a sort of pear shape to the entire organism: the small pole end is soon dropped, however, and becomes momentarily a free coccoid, and goes through the cycle of morpho-development already described; the same occurs with the other pole end.

This concludes my observations of the micro-morpho-biological phases presented by these two micro-etiological organisms in the course of their development. There may be some minor phenomena that have escaped my attention, but I am very sure I have described all the essential points.

The Swine Plague and Southern Cattle Plague Germs Differentiate themselves very sharply by their Appearance when Cultivated on Potatoes.

If we properly prepare (see text-books) and sterilize some nice, clean potatoes, and then place them (*lege artis*) in a sterilized, moist, cultivating chamber, and inoculate the cut surface of some of the potatoes from Agar Agar, Boullion or other cultivations of the microörganisms of these two diseases, we shall invariably find that they can be readily differentiated from one another in the course of from twenty-four to forty-eight hours after the surface of the potatoes has been inoculated. *The growth of the germs of the American Swine Plague will invariably present a peculiar brownish-yellow to the eye, reminding one of coffee color,* especially the variety one gets in the ordinary boarding-house and restaurant.[1]

[1] Colin says "greyish."

On the other hand, the micro-etiological *moment of the Southern Cattle Plague will with equal constancy present a growth of the most delicate straw color during the first day or so of its development, but which soon begins to show a delicate pinkish, red-yellow, and finally quite a decided brick-red-yellow shade, as the cultivation becomes antiquated; this reddish shade begins and grows most intense at the centre of the growth, leaving it more yellow toward its peripheries.*

The Deportment of the Germs of Swine Plague and Southern Cattle Plague in Beef-Infusion Gelatine.

As what is known to us as beef-infusion gelatine cannot be used in hot weather, or when the prevailing temperature is above 75° F. (23° C.), on account of its becoming fluid, I could not use this material until the last moment, and only prepared the first of the season on Saturday last, October 1, and on Sunday was enabled to inoculate tubes of this material with from pure cultivations of the germs of Southern Cattle Plague and hog cholera. This beef-infusion gelatine is an invaluable medium in the technique of bacteriology, for two essential reasons: First, being transparent, one can see what is going on on it, and, secondly, many micro-organisms cause the solid material to become fluid, and present peculiar phenomena to the eye, while others do not cause any change in it, but may grow in a peculiar manner.

Now the hog-cholera germs belong to the latter class, as well as the germ of the German, French and English swine plagues, which are probably identical with hog cholera, as also those of hen cholera, and the peculiar disease known as "wild Seuche" in Germany, which affects the deer tribe and cattle and hogs, and belongs to the same blood-poisoning group as hog cholera.[1] When we take our hog-cholera germ, and inoculate tubes containing this beef-infusion gelatine from the pure agar agar cultures, we shall observe that the germs do not cause the gelatine to become fluid, and that it never becomes so, so far as any influence of the hog-cholera germs goes, if the culture from which the material has been taken was a pure one, that is, contained no other form of micro-organismal life than the germs of hog cholera.

This germ, however, has other peculiarities; it slowly spreads

[1] The germ of the English Swine Plague was first discovered by me in 1886, in some tissues from England belonging to my then assistant, Dr. Bowhill, M.R.C.V.S.

over the surface of the gelatine as a delicate cuticle, but, as these cultures are made by puncturing the gelatine with a wire, the germs are carried into that substance by the wire. Here we observed that everywhere the wire has left a germ in its passage through the gelatine, that a small colony develops, giving to the puncture the appearance of a delicate thread with knots along its course. In the end these colonies unite, and give the puncture a ragged-edged appearance. As the germs of the German swine plague, and rabbit-septicæmia, and the "wild Seuche" all do the same thing, Hueppe asserts them to be the same organism. Hueppe has tried to claim that all these diseases were one and the same, a mistaken view, as I have tried to show.

I have now to chronicle the first serious error, a genuine mistake of carelessness, from undue haste, that I can charge myself with during my investigations of the two micro-etiological organisms here considered.

Above it was said that on October 2d two beef-infusion gelatine tubes were inoculated from pure cultivations of the germ of the Southern Cattle Plague, and in the local papers the following remarks were published:

"Now it became interesting to see how this Southern Cattle-Plague germ would deport itself in this gelatine, because it cannot be distinguished from that of hog cholera under the microscope, or on agar agar, or in bouillon. That it can be by its growth on potatoes has been already noted. Hence, on Sunday, October 2d, gelatine tubes were inoculated. You can judge of my surprise on seeing that this Cattle-Plague germ could be at once distinguished from those of hog cholera standing beside it. The germ of the former had caused the gelatine to become fluid to the bottom of the puncture in twenty-four hours, which is quite rapid work."

The above was scarcely in the hands of the readers of the two journals before I began to have grave doubts of the correctness of my observations, simply because *all other known germs belonging to this "belted" group, and the cause of extra organismal septicæmiæ, do not cause the gelatine to become fluid.*

In order that others may profit by an error which is unpardonable on my part, I will briefly tell how it came about. At the time I had just twenty agar agar cultivations of the germs of the Southern Cattle Plague, which I looked upon as pure, and which represented the outbreak at Tekamah and Roca, my inoculated

steer, and material from a ground squirrel. In making the gelatine tube, *I simply inoculated from one agar agar tube on two gelatine tubes, with no other precaution than a macroscopic comparison of the growth with those in the other agar agar tubes.* I could see no change in the appearance of the growth of the tubes I used. *I should have made, and every one should always make a few cover-glass specimens for the microscopic test in all such cases.* (In the case of these germs, it would be futile, however.) After the cultures in the gelatine had become fluid, I then inoculated the entire agar cultivations (twenty) upon gelatine, and carefully numbered each tube with a corresponding number, so as to control the number.

This time I was not at all surprised where in nineteen of the beef-infusion gelatine tubes no fluidification had taken place, the same occurring in the one as before and from the same agar tube. It is now February 6th, and the tubes remain exactly as they were on the 8th of October.

Hence, *the germs of the Southern Cattle Plague,* like those of the American Swine Plague, and other diseases of the same group, that are caused by the belted oval germs *do not cause fluidification of gelatine media.*

I next inoculated twenty pieces of sterilized potatoes (and for comparison's sake twenty others from cultivations of the Swine-Plague germ), and here *I found no change in the appearance of the growths from those previously described.* From the twenty potatoes culture of the Southern Cattle Plague germ I again inoculated twenty gelatine tubes. *Nineteen remained solid; one became fluid.* As the potato culture from the tubes which caused the gelatine to become fluid did not show any variation in the color of the growth upon agar agar from the others, I resorted to plate cultivations as well as the microscope to solve the riddle.

This one tube contained a small number of the most contemptibly small micrococci, yet enough to have got me into a serious error. They required 2,000-diameter amplification to see them distinctly, and, as I have said, Micrococci constitute a normal morphos in the development of this class of germs, their presence would have excited no suspicions had I subjected the original culture to a microscopic examination. Still it should be done in every case, so as to keep up a good rule.

They were separated with ease on plates. Inoculation upon Gophers with the mixed culture gave fatal results, but no cocci

could be found in their blood or tissues, nor did any develop in tubes inoculated from them. Inoculation upon Gophers and mice with pure cultivations of the troublesome cocci gave absolutely negative results, no disturbance except a little stiffness and swelling of the limb occurring.

The reason that the color of the agar agar, and especially potato cultures of the Swine Cholera-Plague germ was not affected by these cocci was that the former are so much larger and grow so much faster as not to be much affected thereby on that medium; while in gelatine this whole group of germs finds a poor nutrient material, and grow very slowly; on the contrary, the small cocci grew exceedingly fast in the gelatine, and also caused its fluidification with greater rapidity than any pathogenetic organism with which I am acquainted, not excepting Finkler's and the cheese "Comma." Second, they are almost transparent, and have no chromogenic properties.

That they had less specific gravity than the Southern Cattle-Plague germ could be determined by a microscopic examination of the material at the apex of the fluidification, by tipping the tubes gently; here the Southern Cattle Plague organism greatly predominated.

The Growth of the Germs of Southern Cattle Plague in Beef-Infusion Gelatine as Compared with those of the American Swine Plague.

While neither of these micro-organisms cause fluidification of the beef-infusion gelatine, still there are certain minor points which have a degree of differentiating value for each of them.

The germs of the Southern Cattle Plague have more desire for the air than those of the Swine Plague, they are more ærobic; *while they spread slowly over the surface of the gelatine, still they do it more rapidly than the swine-plague organism.* Along the line of puncture in the substance of the gelatine there is, however, no perceptible difference in the deportment of the two germs.

They each form individual colonies along the line, which gives to it an irregular jagged appearance, resembling the cutting edge of a saw.

If anything, this surface is more dentoid in the Southern Cattle Plague cultures than the Swine Plague growths in beef-infusion gelatine.

This concludes my present observations upon the development of these etiological organisms in and on different cultivating media. Not having a refrigerator, I have not compared their developments upon blood serum up to the present time.

Now these facts of some of the biological (or life) characteristics of these two germs show that, while two germs may look alike and grow alike, even in every particular, they may have one other attribute which in such cases can only be relied upon to detect one from the other.

That is their origin or, in other words, their disease-producing action.

It needs no argument from me for the practical farmer to know that the Southern Cattle Plague will not produce hog cholera in his hogs, or the latter disease the Southern Cattle Plague in his cattle.

ON SOME INTERESTING DERIVATIONS OF MINERAL NAMES.

BY F. M. ENDLICH.

(Continued from January Number.)

3. In addition to those mineral names which have undergone curious changes in the course of time, there are others which show interesting etymological relations, and yet have descended to us in but slightly changed form.

KERMESITE is derived from the Sansk. *krimi*, worm; Pers., *kirm* or *kirmis*, scarlet; Ar., *alkirmis;* Sp., *alkermes;* G. obs. *Kermes*, the "scarlet bug," cochineal insect. *Chermes*, the druggists' name for the substance, reached Spain from Arabia and thence travelled to Italy and Germany.[1]

The Sansk. form *krimi* has been retained in our Engl. *crimson*. It is also recognizable in the Lithuanian *kirminis*, worm. In It., Fr. and, later, Sp., the letter *a* was substituted for *i* and *e*, resulting in *carminio* and *carmine:* whence the mineral name *Carminite*.

[1] "Chermes vocant Arabes vnde nos chermesinum; sev et vermilium vsurparunt quidam, a vermiculis exemptis a radice pimpinellæ; coccum autem alio nomine dicitur scarlattum." (Cæsius, 1636.)